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QUALIFICATION TESTING OF
CORRUGATED HIGH-DENSITY POLYETHYLENE CONTAINERS

HQ AFMC/LGTP
AIR FORCE PACKAGING EVALUATION ACTIVITY
Wright-Patterson AFB OH 45433-5999
October 1992

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ABSTRACT

In November 1991, Oklahoma City Air Logistics Center (OC-ALC) requested the Air Force Packaging Evaluation Activity (AFPEA) evaluate a new concept of a heavy corrugated high-density polyethylene material as an alternative to wood material for PPP-B-601 containers. This material is waterproof and could save in weight upon deployment.

AFPEA performed testing in February 1992 on three different sizes of the plastic corrugated containers. All three passed the Level B rough handling and vibration tests, and with some modification, the containers passed the superimposed load test. AFPEA recommends the container as an alternative to PPP-B-601 boxes with the changes listed in the recommendations.

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PUBLICATION DATE:

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INTRODUCTION

BACKGROUND: Oklahoma City Air Logistics Center/DSTD, Tinker AFB, Oklahoma requested assistance from the Air Force Packaging Evaluation Activity (AFPEA), Wright-Patterson AFB, Ohio to investigate, evaluate, and test plastic corrugated containers as an alternative to PPP-B-601 constructed boxes, "Boxes, Wood, Cleated Plywood". The new containers consist of heavy corrugated high-density-polyethylene material. The material could save in weight because the plastic corrugated material is lighter than its cleated plywood counterpart.

PURPOSE: The purpose of this project is to investigate, evaluate and test the corrugated plastic containers for use by the military for Level B shipment.

DESCRIPTION OF TEST CONTAINERS

Three sizes of containers were tested. A 2-foot-cubed size, a 3-foot-cubed size, and a 4-foot-cubed size (See Figure 1). The container material consists of 2500 pound per square inch (tensile strength) high-density polyethylene corrugated. The polyethylene material makes this container waterproof and more lightweight than its wooden counterpart. A machine is used to bend the corrugated board. The machine uses heat, pressure and time to bend the board. The container base is constructed similar to a fiberboard box (PPP-B-636) but using the plastic corrugated material. The container lid is a cap also constructed of corrugated material. The container uses plastic banding to secure its contents. Square tubular high-density polyethylene cornerposts help with stacking strength. The original design did not include cornerposts, but because the original design failed during the superimposed load test, the manufacturer redesigned the containers to include cornerposts.

TEST OUTLINE AND TEST EQUIPMENT

Test Plan: Tests were conducted in accordance with AFPEA Test Plan 91-P-120 (see Appendix A). The tests were developed to evaluate the structural integrity of the containers needed for Level B shipment. Test methods, procedures and pass/fail criteria were in accordance with Federal Test Method Standard 101.

Test Loads: The test loads were sand-filled fiberboard boxes. The test weight for the four-foot-cubed container was 750 pounds. The test weight for the three-foot-cubed container was 500 pounds. The test weight for the two-foot-cubed container was 250 pounds.

Test Site: All testing was conducted by the Materials Engineering Branch of AFPEA, HQ AFMC/LGTP, Building 70, Area C, Wright-Patterson AFB, OH 45433-5999.

TEST PROCEDURES AND RESULTS

TWO-FOOT-CUBED CONTAINER

Cornerwise-Drop Test

Test No. 1: The cornerwise-drop (rotational) test was performed in accordance with Method 5005.1 of FTMS 101. The drop height was 24 inches (see Figure 2).

Results: Visual inspection revealed no damage to the container.

Edgewise-Drop Test

Test No. 2: The edgewise-drop test was performed in accordance with Method 5008.1 of FTMS 101. The drop height was 24 inches (see Figure 3).

Results: Visual inspection revealed no damage to the container.

Pendulum Impact Test

Test No. 3: The pendulum impact test was performed in accordance with Method 5012 of FTMS 101. The impact velocity was 7 feet per second and the corresponding drop height was 9 inches (See Figure 4).

Results: Visual inspection revealed slight twisting of the skids.

Repetitive Shock Test

Test No. 4: The repetitive shock test was performed in accordance with Method 5019.1 of FTMS 101. Vibrated container at one inch double amplitude for two hours. A 1/16 inch maximum clearance was maintained at a frequency of 4.5 ± 0.2 Hz.

Results: Visual inspection revealed no damage to the container.

Superimposed Load Test

Test No. 5: The superimposed load test was conducted in accordance with Method 5016.1 of FTMS 101. A load of 1946 pounds (determined from a 16-foot warehouse stack) was placed on top of a skid base simulating the skid of the test container. The skid base and its load were placed on top of the test container and left for 168 hours in a chamber at 120°F and 90% Relative

Humidity. The higher temperature and humidity are required because of the plastic material.

Results: The test was stopped when the test engineer observed that the load had fallen off. The container was buckled on edges 1-8 and 6-7. The load fell on the 3-foot-cubed container (see Figure 5).

Note: The manufacturer redesigned the container after this test (5A). They added square tubular high-density polyethylene corner posts. Following are the results of the second superimposed load test (5B).

Results 5B: Visual inspection revealed no damage to the container.

THREE-FOOT-CUBED CONTAINER

Cornerwise-Drop Test

Test No. 1: The cornerwise-drop (rotational) test was performed in accordance with Method 5005.1 of FTMS 101. The drop height was 21 inches (see Figure 6).

Results: Visual inspection revealed minor cracking in corner 7-8 (see Figure 7).

Edgewise-Drop Test

Test No. 2: The edgewise-drop test was performed in accordance with Method 5008.1 of FTMS 101. The drop height was 21 inches.

Results: Visual inspection revealed no damage to the container.

Pendulum Impact Test

Test No. 3: The pendulum impact test was performed in accordance with Method 5012 of FTMS 101. The impact velocity was 7 feet per second and the corresponding drop height was 9 inches (see Figure 8).

Results: Visual inspection revealed minor cracking/chipping of middle skids (see Figure 9).

Repetitive Shock Test

Test No. 4: The repetitive shock test was performed in accordance with Method 5019.1 of FTMS 101. Vibrated container at one inch double amplitude for two hours. A 1/16 inch maximum clearance was maintained at a frequency of 4.5 ± 0.2 Hz.

Results: Visual inspection revealed no damage to the container.

Superimposed Load Test

Test No. 5: The superimposed load test was conducted in accordance with Method 5016.1 of FTMS 101. A load of 2405 pounds (determined from a 16-foot warehouse stack) was placed on top of a skid base simulating the skid of the test container. The skid base and its load were placed on top of the test container and left for 168 hours in a chamber at 120°F and 90% Relative Humidity. The higher temperature and humidity are required because of the plastic material.

Results: The test was stopped when the test engineer observed the two-foot-cubed container's load had fallen on the 3-foot-cubed container and the 4-foot-cubed container's severe buckling was interfering with the 3-foot-cubed container's test also (see Figures 11 & 12).

Note: The manufacturer redesigned the container after this test (5A). They added square tubular high-density polyethylene corner posts. Following are the results of the second superimposed load test (5B).

Results 5B: Visual inspection revealed no damage to the container.

FOUR-FOOT-CUBED CONTAINER

Cornerwise-Drop Test

Test No. 1: The cornerwise-drop (rotational) test was performed in accordance with Method 5005.1 of FTMS 101. The drop height was 18 inches (see Figure 13).

Results: Visual inspection revealed minor cracking in corner 1-2.

Edgewise-Drop Test

Test No. 2: The edgewise-drop test was performed in accordance with Method 5008.1 of FTMS 101. The drop height was 18 inches (see Figure 14).

Results: Visual inspection revealed minor bending on edge 4-5.

Pendulum Impact Test

Test No. 3: The pendulum impact test was performed in accordance with Method 5012 of FTMS 101. The impact velocity was 7 feet per second and the corresponding drop height was 9 inches (see Figure 15).

Results: Visual inspection revealed no damage to the container.

Repetitive Shock Test

Test No. 4: The repetitive shock test was performed in accordance with Method 5019.1 of FTMS 101. Vibrated container at one inch double amplitude for two hours. A 1/16 inch maximum clearance was maintained at a frequency of 4.5 ± 0.2 Hz.

Results: Visual inspection revealed no damage to the container.

Superimposed Load Test

Test No. 5A: The superimposed load test was conducted in accordance with Method 5016.1 of FTMS 101. A load of 3200 pounds (determined from a 16-foot warehouse stack) was placed on top of a skid base simulating the skid of the test container. The skid base and its load were placed on top of the test container and left for 168 hours in a chamber at 120°F and 90% Relative Humidity. The higher temperature and humidity are required because of the plastic material.

Results 5A: The test was stopped when the test engineer observed severe buckling of the container and instability of the load. Permanent deformations of the container were 5 inches in some places. Edge 6-7 had the most severe buckling. Edges 4-5 and 1-8 were the next severe. The 4-foot-cubed container was also pressing on the 3-foot-cubed container (see Figures 16 & 17).

Note: The manufacturer redesigned the container after this test (5A). They added square tubular high-density polyethylene corner posts. Following are the results of the second superimposed load test (5B).

Results 5B: Visual inspection revealed no damage to the container (See Figure 18).

CONCLUSIONS

The three sizes of containers passed the rough handling and vibration tests. The three containers failed the initial superimposed load test. The manufacturer modified the containers with high-density polyethylene cornerposts. The containers passed the subsequent superimposed load test with this modification.

RECOMMENDATIONS

1. The staples in the slots of the skids make it difficult to reband and cause tearing of straps during shipment and forklift handling. Recommend no stapling or lag bolts in that area.
2. The forklift tines get caught in banding and on edges of base causing handling problems and broken bands. Metal banding should be specified (See Figure 19). A skid redesign may also be helpful in alleviating the problem.
3. The low skid height makes threading shipping bands through the cross slots difficult. Forklift tines can get caught in and break bands. Forklift tines can slide under the container base flaps and cause container damage. Manufacturer design changes are recommended to correct these problems (See Figure 19).
4. High-density polyethylene cornerposts are required in the containers because of the failure of the original containers during the superimposed load test. (See Figure 20).
5. Hard to load/unload larger containers in the 3-foot-cubed size and the 4-foot-cubed size. Users are forced to exceed human factors specifications in lifting items in and out of containers. May cause injury to user. Recommend design change to correct problem.
6. With incorporation of the changes in paragraphs 1-5 above, AFPEA recommends use of this type of container for sizes of Length, Width, and Height from two feet to four feet. The smallest dimension determines maximum weight (2 foot = 250 pounds, 3 foot = 500 pounds, 4 foot = 750 pounds). WR-ALC will establish stock numbers for the three sizes of containers. Stock numbers can be assigned for additional sizes as needed. AFPEA is investigating the possibility of revising an existing specification to include the plastic corrugated containers.

7. The plastic corrugated container is waterproof and is lighter than its wooden counterpart. Following are tare weights for both types of containers:

| <u>Size</u> | <u>Plastic Weight (lb)</u> | <u>Wood Weight (lb)</u> |
|------------------|----------------------------|-------------------------|
| Two-foot-cubed | 40 | 75-100 |
| Three-foot-cubed | 82 | 125-150 |
| Four-foot-cubed | 115 | 175-200 |

The weight savings will be beneficial for aircraft deployment. The box will be lighter than a wooden box, and therefore, it will be easier to handle. The lightness of the container will result in fuel savings upon deployment.

8. An organization can use the container as an alternative to PPP-B-601 wood box for the sizes and weights previously listed. AFPEA does not recommend replacing PPP-B-601 boxes totally. The material availability of the corrugated plastic board is low. Lumber and plywood are more readily available. Also, field activities may not be able to afford the machinery and would not be able to manufacture their own boxes if the corrugated plastic boxes were their only choice.

9. An organization can purchase containers from a manufacturer, or an organization can purchase equipment for in-house container manufacturing if the organization determines the equipment purchase is economically feasible.

Note: Authorized personnel within DoD requiring identification of the manufacturer mentioned in this report may contact the Air Force Packaging Evaluation Activity at DSN 787-4519.

APPENDIX A
TEST PLANS
TABLES 1-3

TABLE 1

| AIR FORCE PACKAGING EVALUATION ACTIVITY (Container Test Plan) | | | | | | AFPEA PROJECT NUMBER 91-P-120 | |
|---|--|---|--|--|-------------------|----------------------------------|-----------|
| CONTAINER SIZE (L x W x D) (INCHES) | | | WEIGHT (LBS) | | CUBE (CU. FT.) | QUANTITY | DATE |
| INTERIOR: | | EXTERIOR: | GROSS: | ITEM: | | | |
| 24 x 24 x 24 | | 26 x 26 x 28 | 278 | 250 | 2.0 | 1 | 22 Jan 92 |
| ITEM NAME | | | | MANUFACTURER | | | |
| CONTAINER NAME Plastic Corrugated Container, (2500 psi board) | | | | | | CONTAINER COST | |
| PACK DESCRIPTION HDPE Corrugated Container assembled to PPP-B-636 and tested to PPP-B-601 Boxes have sliptop, wooden skids and are banded | | | | | | | |
| CONDITIONING Ambient Testing Unless Otherwise Specified | | | | | | | |
| TEST NO. | REF STD/SPEC AND TEST METHOD OR PROCEDURE NO'S | TEST TITLE AND PARAMETERS | CONTAINER ORIENTATION | | INSTRUMENTATION | | |
| 1. | <u>ROUGH HANDLING TESTS</u> | | | | | | |
| a. | FED-STD-101 Method 5005.1 | Cornerwise-drop (rotational) test. Ambient Temp. Drop height 24 inches or maximum allowable with CG. | One drop on each base corner, total of four drops. | | Visual Inspection | | |
| b. | FED-STD-101 Method 5008.1 | Shock (Edgewise-drop) test. Ambient Temp. Drop height 24 inches or maximum allowable with CG. | One drop on each base edge, total of four drops. | | Visual Inspection | | |
| c. | FED-STD-101 Method 5012 | Pendulum-impact test. Ambient Temp. Impact velocity 7 ft/sec, drop height 9 inches. | One impact on each side and each end, total of four impacts. | | Visual Inspection | | |
| 2. | <u>REPETITIVE SHOCK TEST</u> | | | | | | |
| | FED-STD-101 Method 5019.1 | Input excitation of 1-inch double amplitude. Frequency determined by 1/16" clearance from table. Two-hour test. | | | Visual Inspection | | |
| 9 | | | | | | | |
| COMMENTS: | | | | | | | |
| PREPARED BY: <i>Caroline J. Buckey</i> Caroline J. Buckey, Mechanical Engineer | | | | APPROVED BY: Larry A. Wood, Materials Engineering | | | |

AIR FORCE PACKAGING EVALUATION ACTIVITY

(Container Test Plan)

AFPEA PROJECT NUMBER

91-P-120

| CONTAINER SIZE (L x W x D) (INCHES) | | WEIGHT (LBS) | | CUBE (CU. FT.) | QUANTITY | DATE |
|-------------------------------------|--------------|--------------|-------|----------------|----------|-----------|
| INTERIOR: | EXTERIOR: | GROSS: | ITEM: | | | |
| 24 x 24 x 24 | 26 x 26 x 28 | 278 | 250 | 2.0 | 1 | 22 Jan 92 |

ITEM NAME

MANUFACTURER

CONTAINER NAME

Plastic Corrugated Container, (2500 psi board)

CONTAINER COST

PACK DESCRIPTION

HDPE Corrugated Container assembled to PPP-B-636 and tested to PPP-B-601
Boxes have sliptop, wooden skids and are banded

CONDITIONING

Ambient Testing Unless Otherwise Specified

| TEST NO. | REF STD/SPEC AND TEST METHOD OR PROCEDURE NO'S | TEST TITLE AND PARAMETERS | CONTAINER ORIENTATION | INSTRUMENTATION |
|----------|---|--|-----------------------|-------------------|
| 3. | <u>SUPERIMPOSED-LOAD TEST (Stackability with Dunnage)</u> FED-STD-101 Method 5016.1 | Load Container with 250 pounds. Stack 1946 pounds using skid system similar to the container's skid system. Condition for 168 hours at 120°F ±5°F, 90% RH. | Normal Position | Visual Inspection |

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COMMENTS:

PREPARED BY:

APPROVED BY:

TABLE 2

| AIR FORCE PACKAGING EVALUATION ACTIVITY (Container Test Plan) | | | | | | AFPEA PROJECT NUMBER 91-P-120 | |
|---|--|---|--|--|----------------|----------------------------------|-----------|
| CONTAINER SIZE (L x W x D) (INCHES) | | | WEIGHT (LBS) | | CUBE (CU. FT.) | QUANTITY | DATE |
| INTERIOR: | | EXTERIOR: | GROSS: | ITEM: | | | |
| 36 x 36 x 36 | | 38 x 38 x 40 | 582 | 500 | 3.0 | 1 | 22 Jan 92 |
| ITEM NAME | | | | MANUFACTURER | | | |
| CONTAINER NAME Plastic Corrugated Container, (2500 psi board) | | | | | | CONTAINER COST | |
| PACK DESCRIPTION HDPE Corrugated Container assembled to PPP-B-636 and tested to PPP-B-601 Boxes have sliptop, wooden skids and are banded | | | | | | | |
| CONDITIONING Ambient Testing Unless Otherwise Specified | | | | | | | |
| TEST NO. | REF STD/SPEC AND TEST METHOD OR PROCEDURE NO'S | TEST TITLE AND PARAMETERS | CONTAINER ORIENTATION | INSTRUMENTATION | | | |
| 1. | <u>ROUGH HANDLING TESTS</u> | | | | | | |
| a. | FED-STD-101 Method 5005.1 | Cornerwise-drop (rotational) test. Ambient Temp. Drop height 21 inches or maximum allowable with CG. | One drop on each base corner, total of four drops. | Visual Inspection | | | |
| b. | FED-STD-101 Method 5008.1 | Shock (Edgewise-drop) test. Ambient Temp. Drop height 21 inches or maximum allowable with CG. | One drop on each base edge, total of four drops. | Visual Inspection | | | |
| c. | FED-STD-101 Method 5012 | Pendulum-impact test. Ambient Temp. Impact velocity 7 ft/sec, drop height 9 inches. | One impact on each side and each end, total of four impacts. | Visual Inspection | | | |
| 2. | <u>REPETITIVE SHOCK TEST</u> | | | | | | |
| | FED-STD-101 Method 5019.1 | Input excitation of 1-inch double amplitude. Frequency determined by 1/16" clearance from table. Two-hour test. | | Visual Inspection | | | |
| 11 | | | | | | | |
| COMMENTS: | | | | | | | |
| PREPARED BY: <i>Caroline J. Buckey</i> Caroline J. Buckey, Mechanical Engineer | | | | APPROVED BY: Larry A. Wood, Materials Engineering | | | |

| AIR FORCE PACKAGING EVALUATION ACTIVITY (Container Test Plan) | | | | | | AFPEA PROJECT NUMBER 91-P-120 | | |
|---|---|--|-----|--------------|-----------------------|----------------------------------|-----------|------|
| CONTAINER SIZE (L x W x D) (INCHES) | | | | WEIGHT (LBS) | | CUBE (CU. FT.) | QUANTITY | DATE |
| INTERIOR: | | EXTERIOR: | | GROSS: | ITEM: | | | |
| 36 x 36 x 36 | 38 x 38 x 40 | 582 | 500 | 3.0 | | 1 | 22 Jan 92 | |
| ITEM NAME | | | | | MANUFACTURER | | | |
| CONTAINER NAME Plastic Corrugated Container, (2500 psi board) | | | | | | CONTAINER COST | | |
| PACK DESCRIPTION HDPE Corrugated Container assembled to PPP-B-636 and tested to PPP-B-601 Boxes have sliptop, wooden skids and are banded | | | | | | | | |
| CONDITIONING Ambient Testing Unless Otherwise Specified | | | | | | | | |
| TEST NO. | REF STD/SPEC AND TEST METHOD OR PROCEDURE NO'S | TEST TITLE AND PARAMETERS | | | CONTAINER ORIENTATION | INSTRUMENTATION | | |
| 3. | <u>SUPERIMPOSED-LOAD TEST (Stackability with Dunnage)</u> FED-STD-101 Method 5016.1 | Load Container with 500 pounds. Stack 2405 pounds using skid system similar to the container's skid system. Condition for 168 hours at 120°F ±5°F, 90% RH. | | | Normal Position | Visual Inspection | | |
| 12 | | | | | | | | |
| COMMENTS: | | | | | | | | |
| PREPARED BY: | | | | | APPROVED BY: | | | |

TABLE 3

| AIR FORCE PACKAGING EVALUATION ACTIVITY (Container Test Plan) | | | | | | AFPEA PROJECT NUMBER 91-P-120 | |
|---|--|---|--|--|----------------|----------------------------------|-----------|
| CONTAINER SIZE (L x W x D) (INCHES) | | | WEIGHT (LBS) | | CUBE (CU. FT.) | QUANTITY | DATE |
| INTERIOR: | | EXTERIOR: | GROSS: | ITEM: | | | |
| 47 x 47 x 48 | | 49 x 49 x 52 | 865 | 750 | 4.0 | 1 | 22 Jan 92 |
| ITEM NAME | | | | MANUFACTURER | | | |
| CONTAINER NAME Plastic Corrugated Container, (2500 psi board) | | | | | | CONTAINER COST | |
| PACK DESCRIPTION HDPE Corrugated Container assembled to PPP-B-636 and tested to PPP-B-601 Boxes have sliptop, wooden skids and are banded | | | | | | | |
| CONDITIONING Ambient Testing Unless Otherwise Specified | | | | | | | |
| TEST NO. | REF STD/SPEC AND TEST METHOD OR PROCEDURE NO'S | TEST TITLE AND PARAMETERS | CONTAINER ORIENTATION | INSTRUMENTATION | | | |
| 1. | <u>ROUGH HANDLING TESTS</u> | | | | | | |
| a. | FED-STD-101 Method 5005.1 | Cornerwise-drop (rotational) test. Ambient Temp. Drop height 18 inches or maximum allowable with CG. | One drop on each base corner, total of four drops. | Visual Inspection | | | |
| b. | FED-STD-101 Method 5008.1 | Shock (Edgewise-drop) test. Ambient Temp. Drop height 18 inches or maximum allowable with CG. | One drop on each base edge, total of four drops. | Visual Inspection | | | |
| c. | FED-STD-101 Method 5012 | Pendulum-impact test. Ambient Temp. Impact velocity 7 ft/sec, drop height 9 inches. | One impact on each side and each end, total of four impacts. | Visual Inspection | | | |
| 2. | <u>REPETITIVE SHOCK TEST</u> | | | | | | |
| | FED-STD-101 Method 5019.1 | Input excitation of 1-inch double amplitude. Frequency determined by 1/16" clearance from table. Two-hour test. | | Visual Inspection | | | |
| 13 | | | | | | | |
| COMMENTS: | | | | | | | |
| PREPARED BY: Caroline J. Buckey, Mechanical Engineer | | | | APPROVED BY: Larry A. Wood, Materials Engineering | | | |

AIR FORCE PACKAGING EVALUATION ACTIVITY

(Container Test Plan)

AFPEA PROJECT NUMBER

91-P-120

CONTAINER SIZE (L x W x D) (INCHES)

INTERIOR:

47 x 47 x 48

EXTERIOR:

49 x 49 x 52

WEIGHT (LBS)

GROSS:

865

ITEM:

750

CUBE (CU. FT.)

4.0

QUANTITY

1

DATE

22 Jan 92

ITEM NAME

MANUFACTURER

CONTAINER NAME

Plastic Corrugated Container, (2500 psi board)

CONTAINER COST

PACK DESCRIPTION

HDPE Corrugated Container assembled to PPP-B-636 and tested to PPP-B-601

Boxes have sliptop, wooden skids and are banded

CONDITIONING

Ambient Testing Unless Otherwise Specified

| TEST NO. | REF STD/SPEC AND TEST METHOD OR PROCEDURE NO'S | TEST TITLE AND PARAMETERS | CONTAINER ORIENTATION | INSTRUMENTATION |
|----------|---|--|-----------------------|-------------------|
| 3. | <u>SUPERIMPOSED-LOAD TEST (Stackability with Dunnage)</u> FED-STD-101 Method 5016.1 | Load Container with 750 pounds. Stack 3200 pounds using skid system similar to the container's skid system. Condition for 168 hours at 120°F ±5°F, 90% RH. | Normal Position | Visual Inspection |

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COMMENTS:

PREPARED BY:

APPROVED BY:

APPENDIX B
TEST PHOTOGRAPHS
FIGURES 1-19

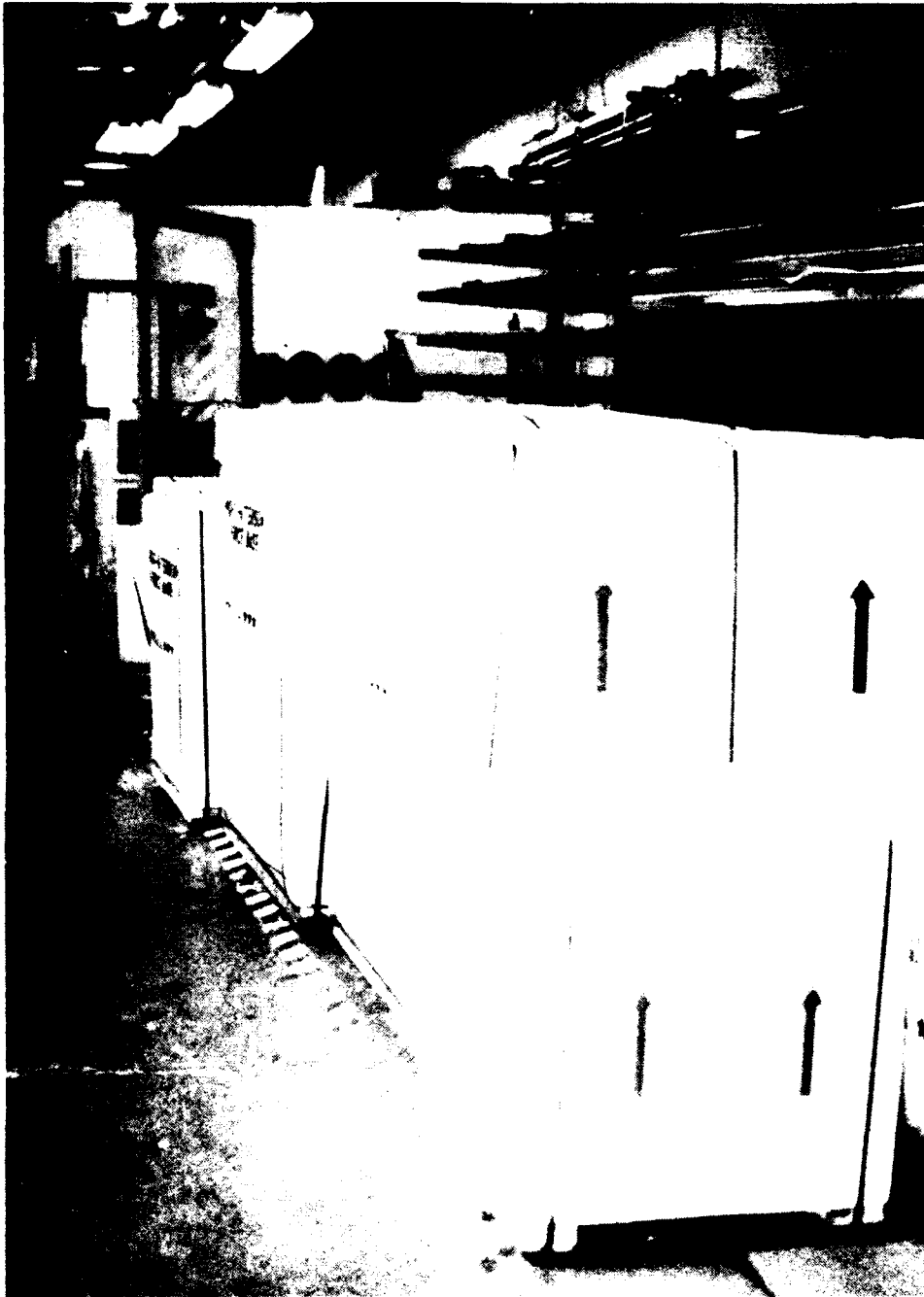


FIGURE 1 - THE THREE CONTAINER SIZES

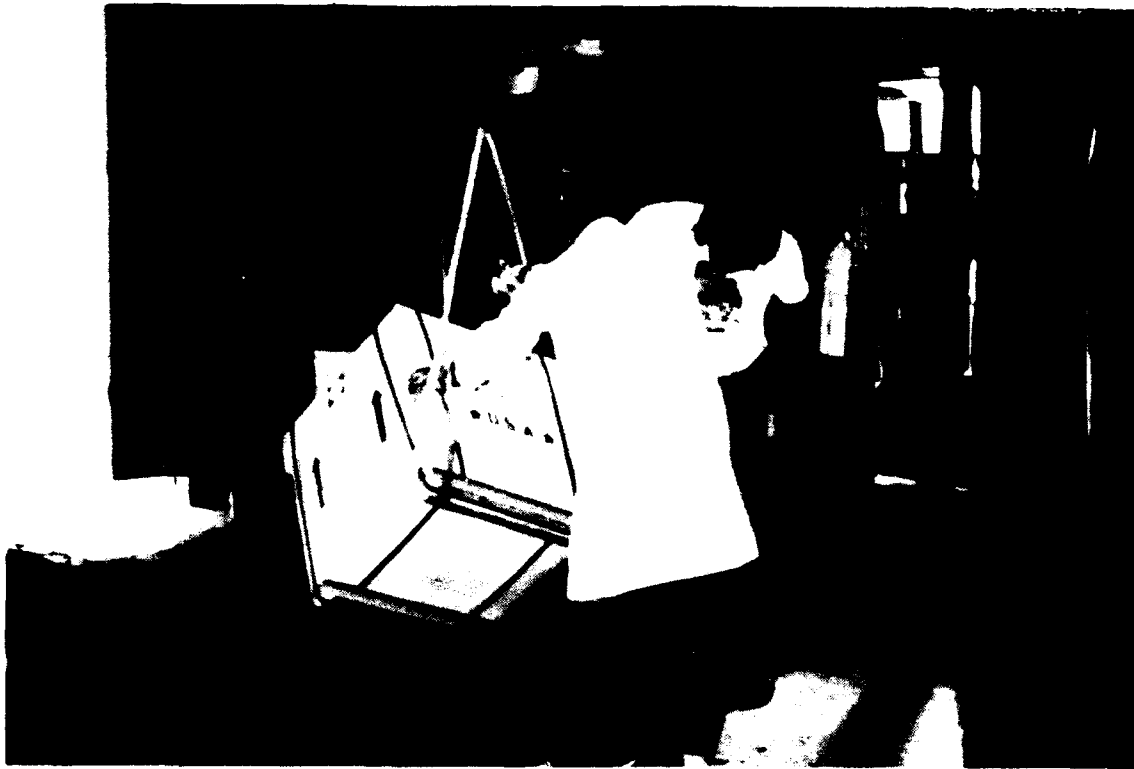


FIGURE 2 - CORNER DROP (TWO-FOOT-CUBED CONTAINER)



FIGURE 3 - EDGE DROP (TWO-FOOT-CUBED CONTAINER)

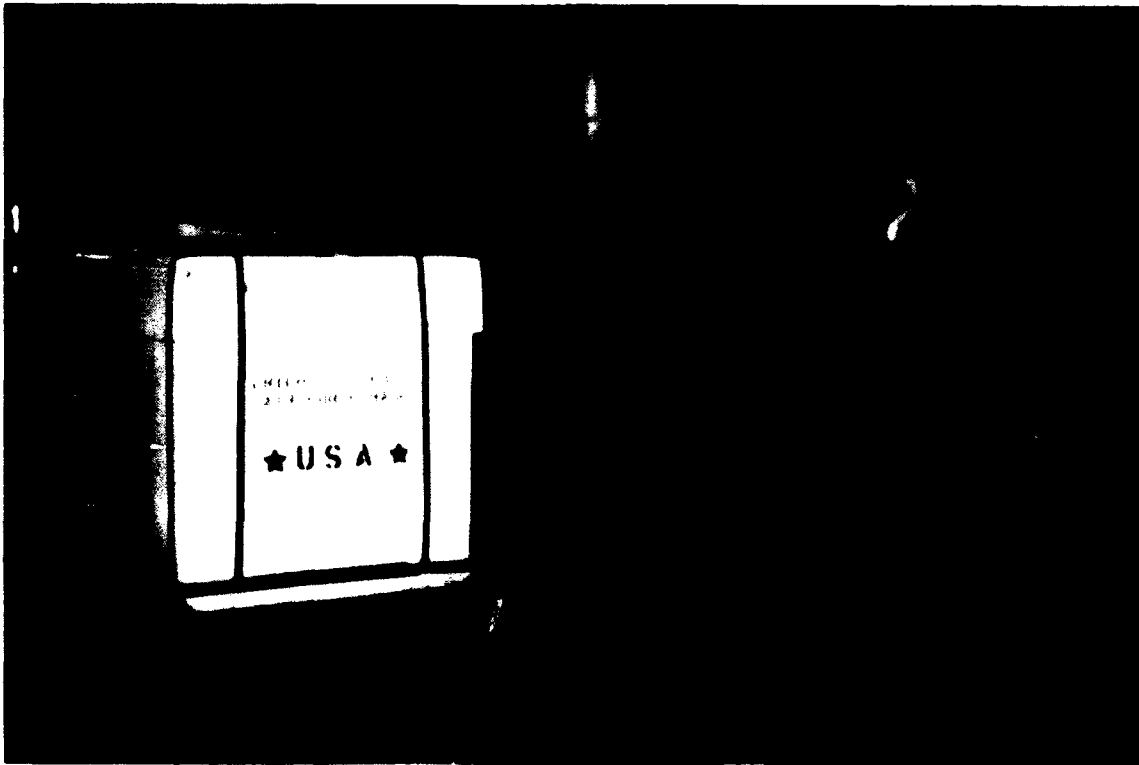


FIGURE 4 - PENDULUM IMPACT (TWO-FOOT-CUBED CONTAINER)



FIGURE 5 - SUPERIMPOSED LOAD BENDING (TWO-FOOT-CUBED CONTAINER)

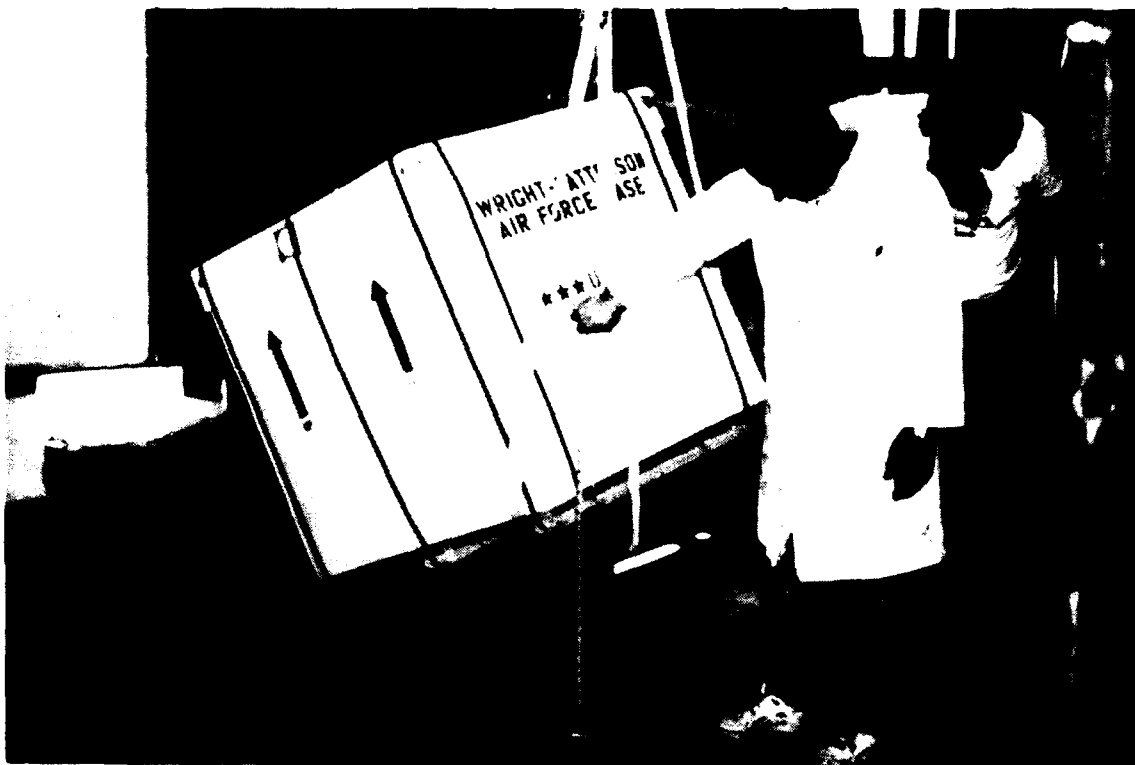


FIGURE 6 - CORNER DROP (THREE-FOOT-CUBED CONTAINER)



FIGURE 7 - SLIGHT CORNER SPLITTING (THREE-FOOT-CUBED CONTAINER)

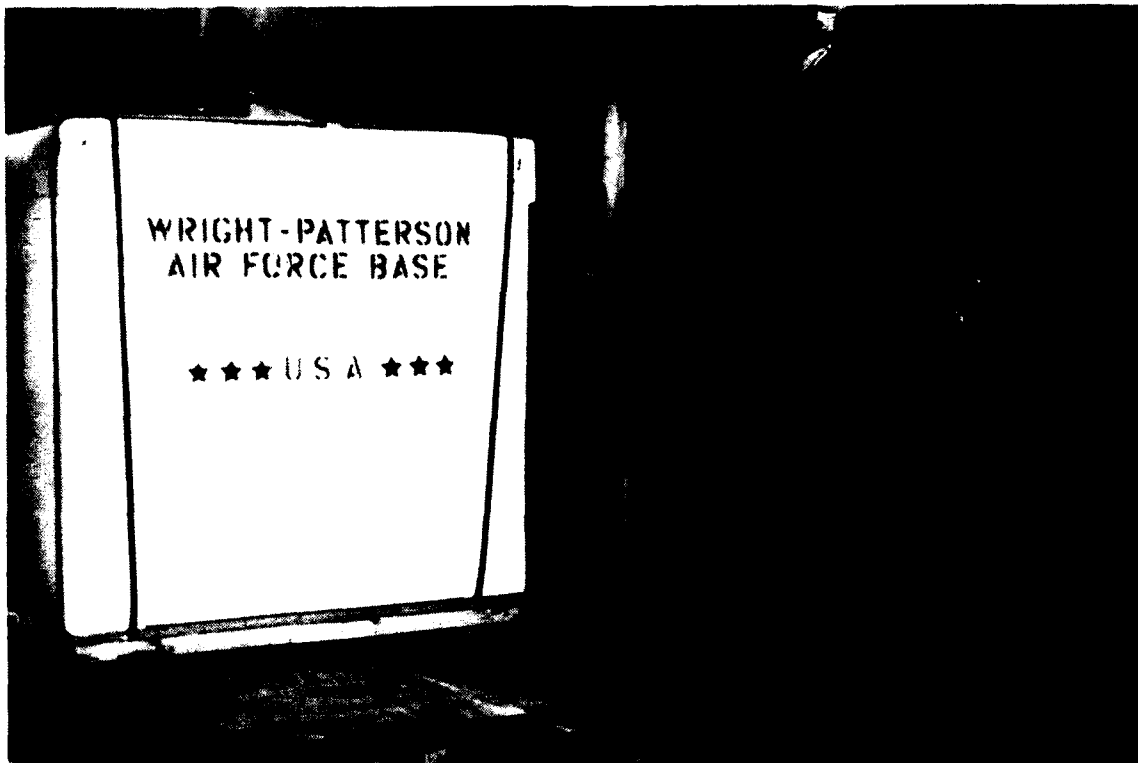


FIGURE 8 - PENDULUM IMPACT (THREE-FOOT-CUBED CONTAINER)

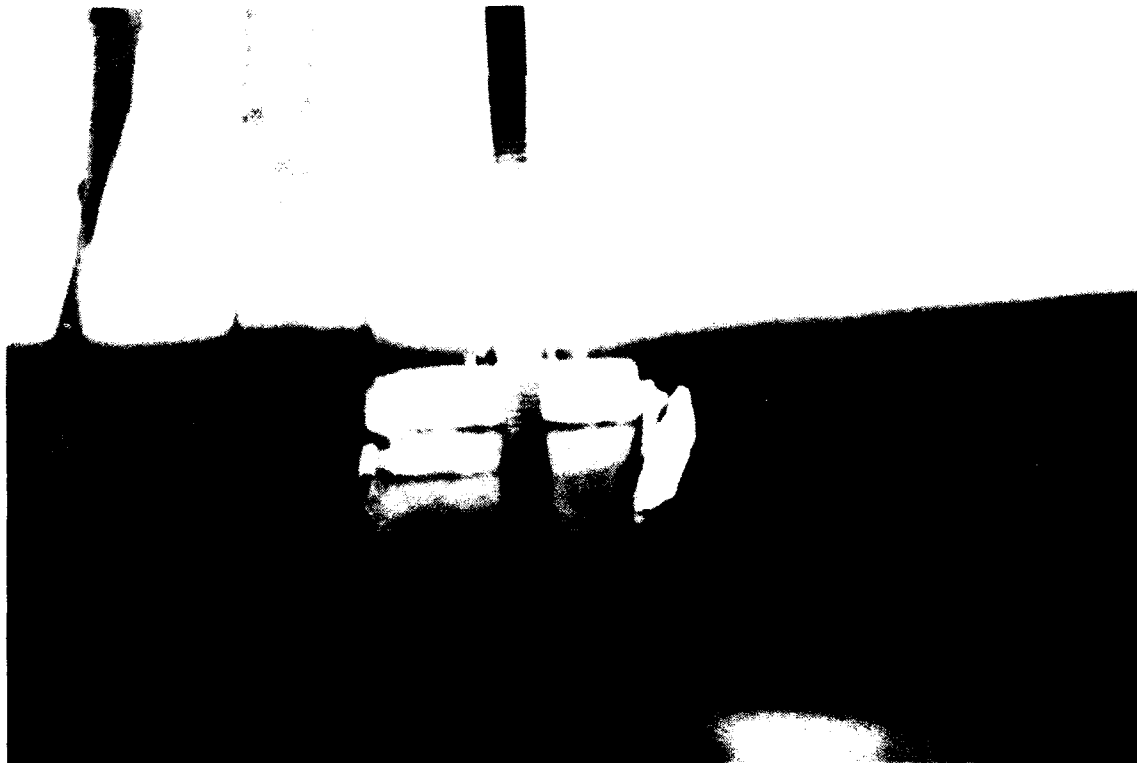


FIGURE 9 - SOME CHIPPING OF SKID (THREE-FOOT-CUBED CONTAINER)



FIGURE 10 - VIBRATION (THREE-FOOT-CUBED CONTAINER)



FIGURE 11 - SUPERIMPOSED LOAD BENDING (TWO-FOOT-CUBED CONTAINER'S
LOAD HAD FALLEN ON THE THREE-FOOT-CUBED CONTAINER)



FIGURE 12 - SUPERIMPOSED LOAD SEVERE BUCKLING (FOUR-FOOT-CUBED
CONTAINER INTERFERING WITH THREE-FOOT-CUBED CONTAINER)

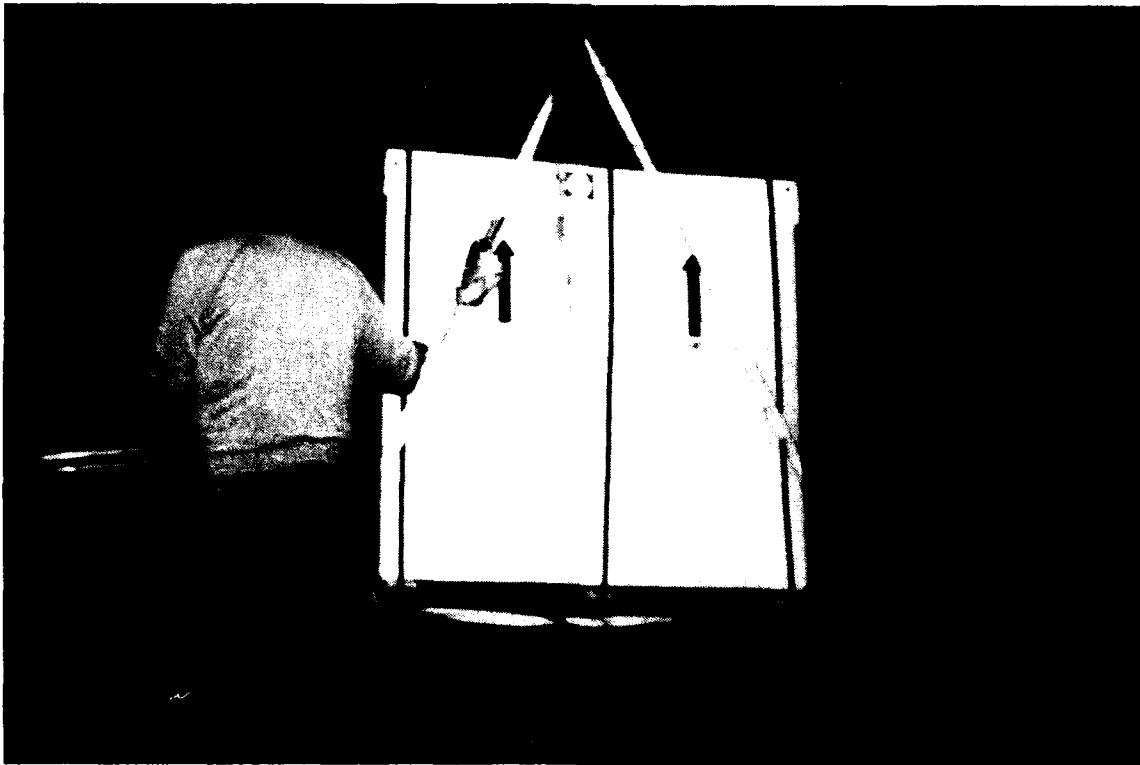


FIGURE 13 - CORNER DROP (FOUR-FOOT-CUBED CONTAINER)

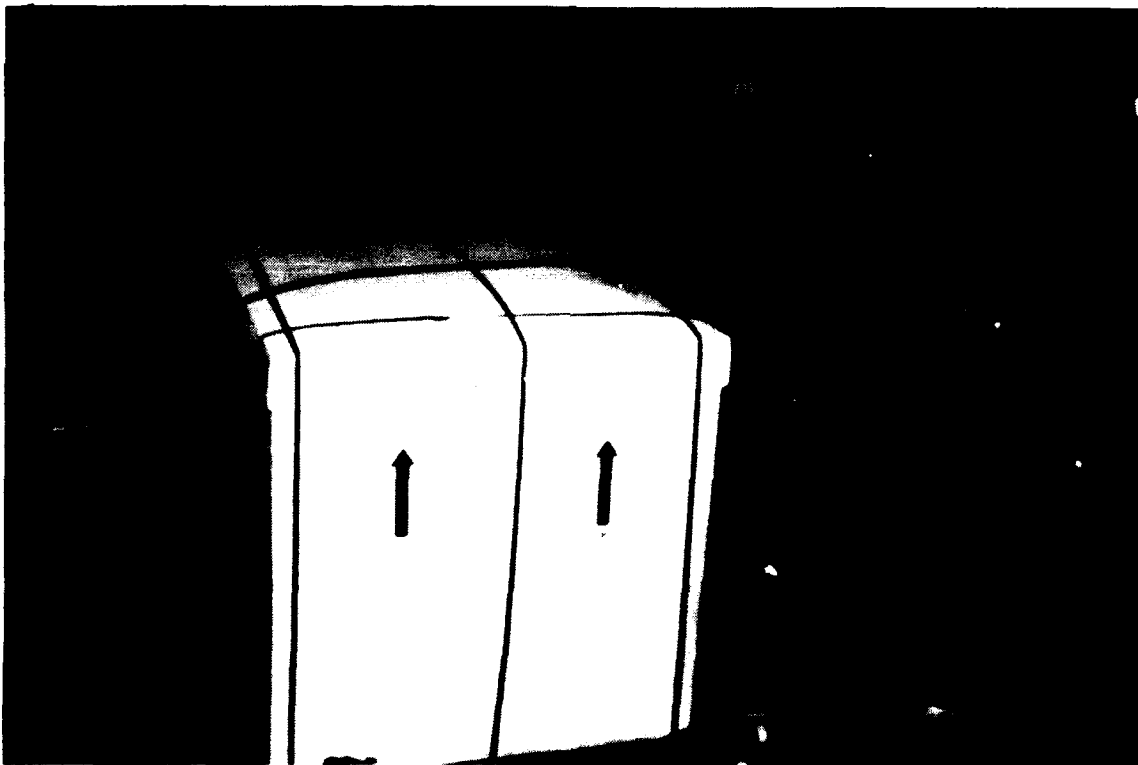


FIGURE 14 - EDGE DROP (FOUR-FOOT-CUBED CONTAINER)

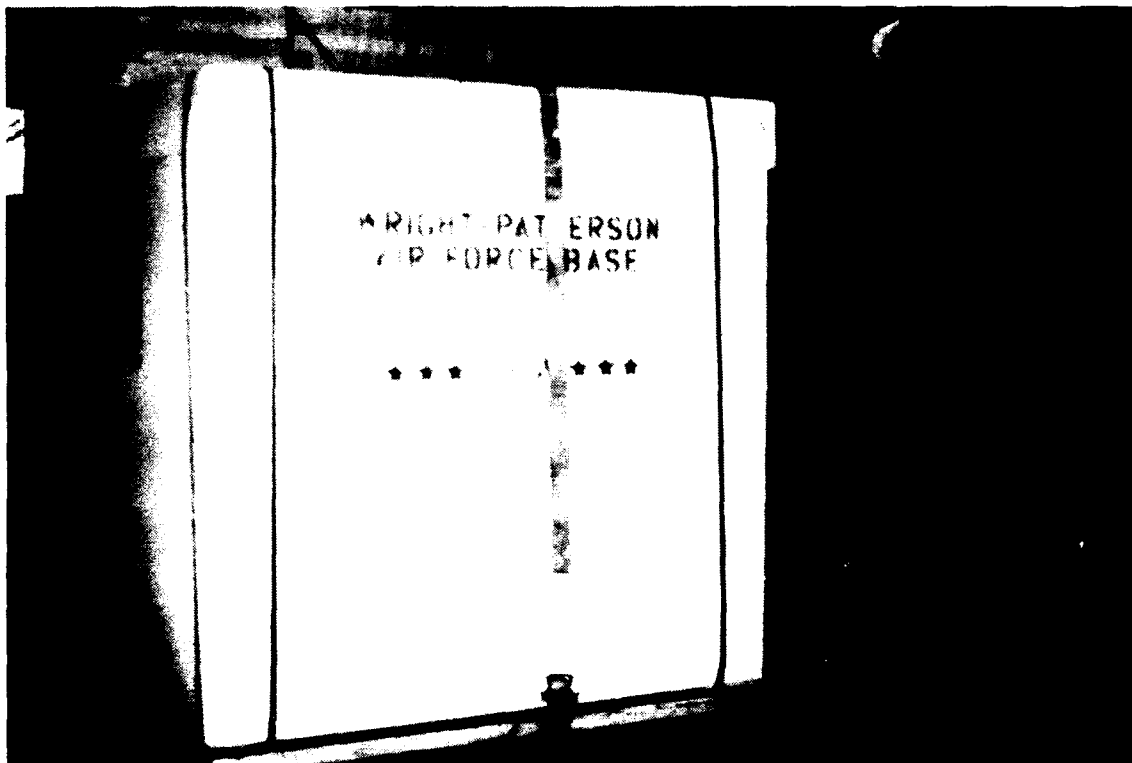


FIGURE 15 - PENDULUM IMPACT (FOUR-FOOT-CUBED CONTAINER)



FIGURE 16 - SEVERE BUCKLING (FOUR-FOOT-CUBED CONTAINER)

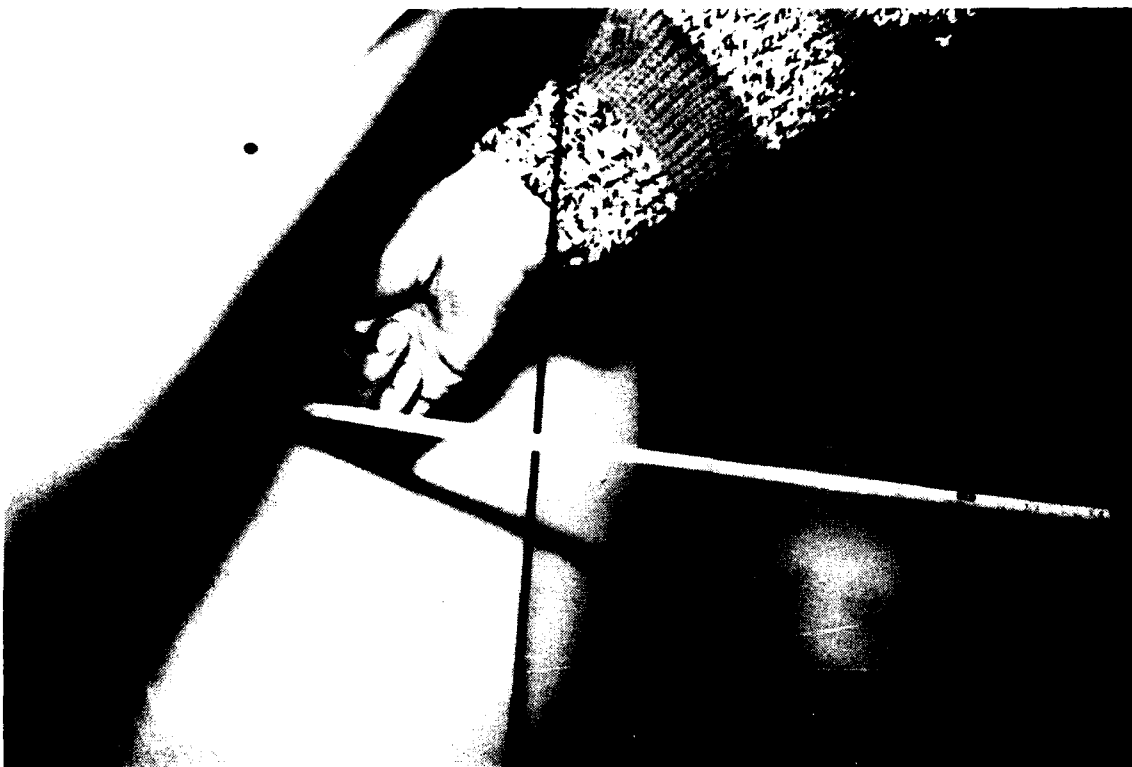


FIGURE 17 - FIVE INCH DEFLECTION (FOUR-FOOT-CUBED CONTAINER)



FIGURE 18 - PASSING SUPERIMPOSED LOAD
(FOUR-FOOT-CUBED CONTAINER)



FIGURE 19 - STRAPS CAUGHT ON FORKLIFT

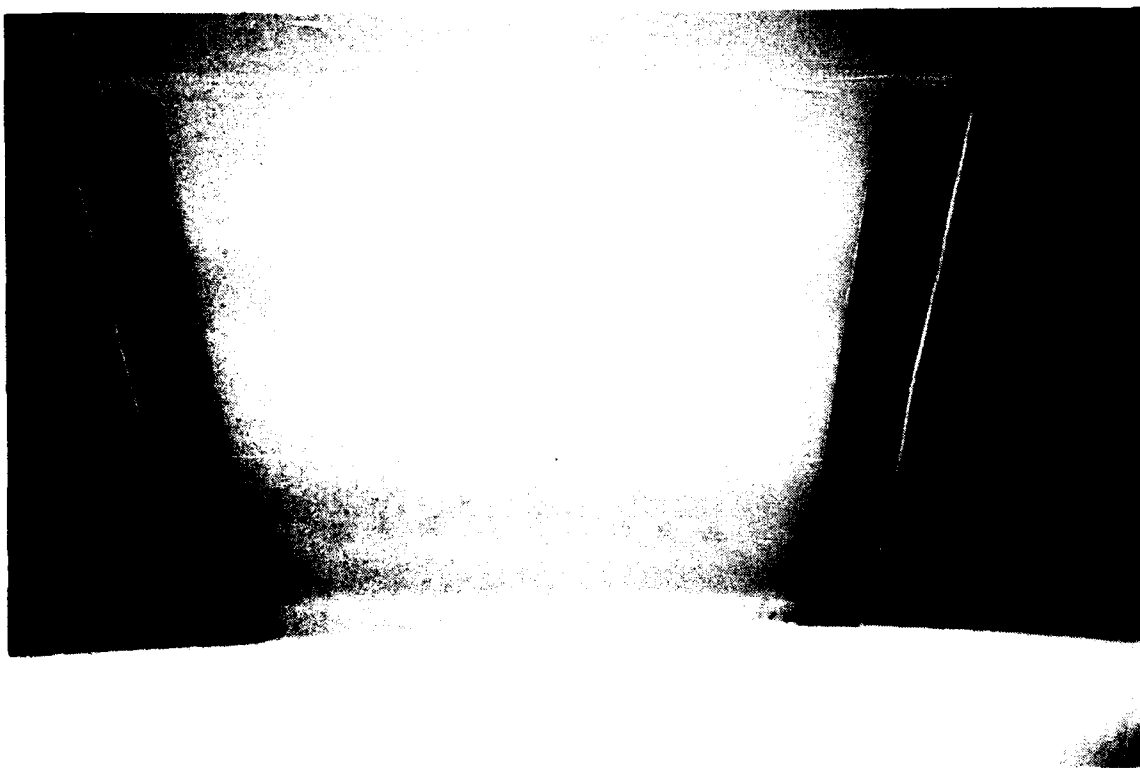


FIGURE 20 - CONTAINER WITH CORNERPOSTS

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